Amendment to the Specification

Please amend the paragraph starting on page 1, line 28 and ending on page 2, line 2 with the following:

Usually the air/oxidant is externally pre-heated, as taught in U.S. Patent Specification 5,413,879 (Domeracki et al.), and also internally heated, by passing the air through a combustion chamber before entry into the interior of the fuel cell, as taught by ~~Zarafed~~Zafred et al. in Fig. 4 of U.S. Patent Specification No. 5,573,867. This is also shown in U.S. Patent Specification No. 4,664,986 (Draper et al.) where metal finned inserts were used within the air/oxidant ~~feel~~feed conduits, within the combustion chamber/pre-heater section, to increase heat transfer.

Please amend the paragraph on page 2, lines 23-31 with the following:

What is needed is an air preheating system which is an integral part of the generator so that the conduits and plena that are used to convey the air to the generator can be constructed from more conventional materials such as the common steels, plastics or fiberglass. Ducting would not need to be insulated. Furthermore, it is preferable that elements of the air delivery system can be very effectively sealed to prevent leakage of air from the air feed plenum to the exhaust plenum, thus ensuring that all of the air which is pumped has value in the electrochemical and thermal scheme. The existence of an integral air preheater which ensures the delivery of cool air to the module facilitates this objective.

Please amend the paragraph on page 6, lines 10-23 with the following:

For operation, gaseous oxidant, typically air is introduced into the fuel cell, generally through an air feed tube. The terms "oxidant" and "air" are used interchangeably here. The air, discharged near the closed end of the cell, flows through the annular space formed by the cell and ~~is~~ coaxial feed tube. Gaseous fuel flows on the outside of the cell. Typically, 85% of the fuel is electrochemically utilized (reacted) in the active fuel cell section resulting in spent fuel. The gas-impervious electrolyte does

not allow nitrogen to pass from the air side to the fuel side, hence the fuel is oxidized in a nitrogen free environment, averting the formation of NO_x. At the open end of the cell, the remaining fuel is reacted with the air stream exiting the cell, reacted spent air, thereby providing additional useful heat. Reformation of natural gas and other fuels containing hydrocarbons can be accomplished, if desired, externally or within the generator. Incoming fuel can be reformed to H_2 and CO within the generator, eliminating the need for an external reformer.

Please amend the paragraph on page 8, lines 16-19 with the following:

We will now discuss variants of the invention shown in Figs. 2, 3, 4 and 5. ~~H~~In all these variants, air 14 at room temperature is pumped by a blower 16 and passes thru a conduit 26 which is fabricated from carbon steel, plastic, or fiberglass and which requires no insulation.

Please amend the paragraph starting on page 8, line 20 and ending on page 9, line 3 as follows:

In the variant illustrated by Fig. 2, the air feed conduit 26 discharges into low temperature air manifold feed plenum 80 which is constructed from carbon steel, plastic or fiberglass or depending upon the size of the generator or into a number of such manifolds. Flexible air feed transport tubes 82, preferably of silicon rubber or an equivalent elastomeric material, connect in a sealed manner between each port 84 of the manifold and an alumina or mullite air feed tube 34 which delivers air to a plurality of SOFC 42 of tubular or multiple passage form. These flexible tubes 82 are considered an extension of the mullite feed tubes 34. In this variant it is preferable to allow the manifold chamber 94 which contains the manifold(s) and the rubber tabulations to be filled with exhaust gas from an exhaust gas chamber ~~94~~96 which, by virtue of the fact that the exhaust gas is stagnant and will exist at a low temperature. Metallic heat conducting inserts 90, such as stainless steel or Inconel radiation fins or ribbon is also shown, interior to the air feed tubes 34 to allow more effective heating in the interior

heat transfer zone 92. Within the 92 there are annular passages 98 for heat transfer passage of the combusted exhaust products 67.

Please amend the paragraph on page 9, lines 13-25 with the following:

As can be seen in Fig. 2 ambient oxidant/air 14 is passed into the generator 10 by, for example, blower 16 via air delivery conduit ~~16~~26, passing into low temperature manifold 80 made from low temperature materials – useful below about 800°C or even lower, that is, common steel or, preferably, plastic, fiberglass or the like, in manifold chamber 94, thence via flexible air transport tubes 82 into air feed tubes 42, generally made of a ceramic such as mullite and possibly containing interior metallic inserts 90 for heat transfer purposes. The air continues to the bottom of the SOFC's 42 where it reverses flow at point 100 and passes upward, within the annular space 102 between the air feed tube 34 and the air electrode, along air electrode surface 72 to provide spent air which reacts with spent fuel 66 in combustion chamber 38. The feed fuel 44 passes through a variety of reforming means 50, 56 and the reformed fuel 58 passes up the outside exterior fuel electrode 64 of the SOFC's 42, within the generator section 62, to recirculation chamber 68 and combustion chamber 38, much as previously discussed in Fig. 1.

Please amend the paragraph on page 10, lines 8-21 with the following:

In Figs. 2 and 3, to improve heat transfer to the process sir, round metallic inserts 90 can be hung from the open ends of the air feed tubes and extend downward within the tubes over a length at least equal to the air interior heat transfer zone 92. Because the lower section of each insert (enhancer) might reach a temperature close to 900°C, this component would be fabricated from a high alloy steel such as Inconel 600 or Inconel 601. The function of the insert 90 is two-fold. Firstly, the insert improves the convective heat transfer between the inside wall of the air feed tube and the air ~~be~~by reducing the hydraulic diameter of the passage. Secondly, when the temperature is high, the insert acts as a radiation fin insomuch as it collects heat by radiation from the

inside wall of the air feed tube and transfers the heat by convection from ~~is~~its exterior surface to the air. In one of the means of accomplishing start-up heating which is described later, the lower part of the insert is an electric heating element and in this version the enhanced/heater assembly might extend within the air feed tube to a level below the top of the combustion chamber 38.

Please amend the paragraph starting on page 11, line 26 and ending on page 12, line 10 with the following:

The zone 92 block structure might be formed from a stack of fibrous ceramic boards which are cemented together before being drilled to accept the air feed tubes, of the structure might be a net shape ceramic casting. The mass flow rate of the exhaust stream is only slightly higher than that of the air feed stream. The mean specific heats of the two streams is also very similar. Consequently, the temperature rise of the air within the zone 92 will be approximately 5% higher than the temperature fall of the exhaust stream. Accordingly, the temperature of the exhaust stream, as it leaves the heat transfer block zone and enters the exhaust plenum 96 is only slightly higher than the sum of the inlet air temperature and the temperature rise of the gases within the generator and combustion chamber. Measurements of exhaust stream temperature for a recently constructed 5 kW experimental generator which used the technology disclosed here place the temperature at approximately 300°C (575°F). The~~he~~ significance of this lies in the fact that only a modest thickness of insulation is required between the exhaust plenum and the plenum which is directly above it and which contains the rubber or elastomeric seal components of the air delivery system, shown primarily in Figs. 3 and 4.

Please amend the paragraph on page 13, lines 15-25 with the following:

Another means of start-up heating is illustrated by Fig. 6. In this arrangement approximately 50% of the air which is pumped by blower 16 is diverted by means of valves 112 through an electrically energized heater 114 into an opening 118 in the

combustion chamber 38. It is noteworthy that the valves operate at low temperature at all times. The air is then discharged at high temperatures into the combustion chamber 38 whereupon it flows into annular passages 98 of the interior heat transfers zone/block 92 and heats the fraction of the air which takes the normal path of ~~ht~~hot air delivery system. Recirculation of an N_2/H_2 mixture 110 serves to promote uniformity of heating and prevents oxidation of the fuel electrode of the SOFC's. This system preserves the option to use elastomeric seals in the air delivery system and preserves the ability of the heaters to function as power dissipaters.